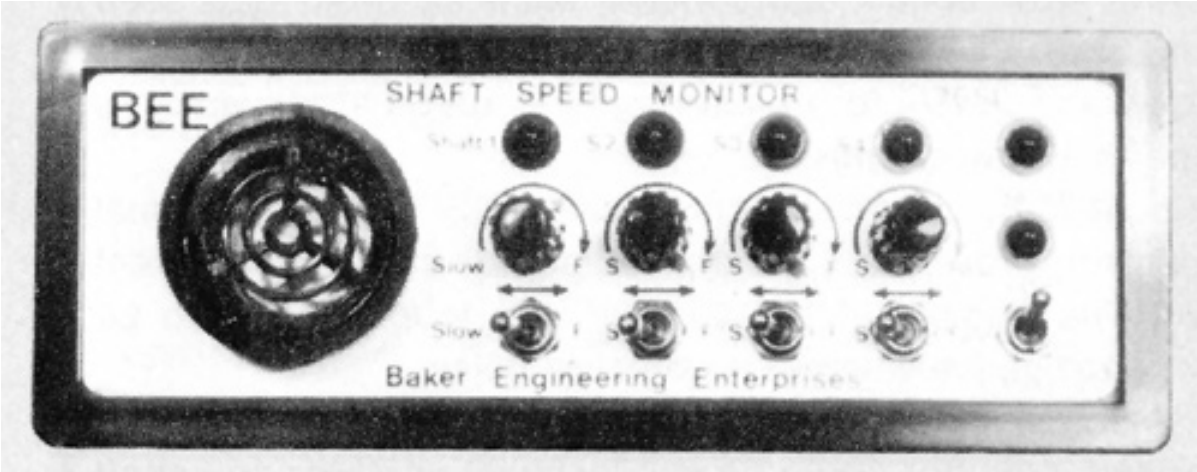
Evaluation Report No. E0277A
Printed: June, 1978
Tested at: Portage la Prairie
ISSN 0383-3445

Evaluation Report 45



Bee Model 7614 Shaft Speed Monitor

A Co-operative Program Between

ALBERTA FARM MACHINERY RESEARCH CENTRE

PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

BEE MODEL 7614 SHAFT SPEED MONITOR

MANUFACTURER
and
DISTRIBUTOR:
Baker Engineering Enterprises Ltd.
Box 8340 Station 'F'
Edmonton, Alberta
T6H 4W6
RETAIL PRICE:
$350.00 (April 1978, f.o.b. Humboldt with 4 channel control box, combine detector package, drill detector package)

SUMMARY AND CONCLUSIONS

The BEE model 7614 shaft speed monitor was suitable for monitoring both slow and high speed shafts on agricultural machines and for signalling the operator that machine components had stopped or were operating at too slow a speed. The model 7614D slow speed detector package was suitable for monitoring slow speed components such as grain drill seed metering shafts while the model 7614C high speed detector package was suitable for monitoring high speed shafts such as on combine straw choppers.

The control box channel lights were bright enough to signal the operator providing the control panel was not in direct sunlight. The audible channel alarm was loud enough to be clearly heard above tractor or combine noise.

By selection of suitable detectors and pickups, the BEE shaft speed indicator could be successfully used for any shaft speed below 3600 rpm. System sensitivity was adequate for all applications. It was found most suitable to adjust sensitivity to cause the operator alarm to be triggered with a 20% drop in component speed. Response time was about 60 seconds for slowly turning shafts and was virtually instantaneous for high speed shafts. Response time was adequate for all applications.

The monitoring system could be installed in about five hours on a multiple grain drill hookup and could be installed in about four hours on a self-propelled combine. Alignment of high speed detectors was difficult due to a limited range of adjustment in the detectors and mounting brackets.

The operator's manual clearly outlined installation, operation and adjustment of the monitor.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Supplying stronger detector mounting brackets.
2. Increasing the range of adjustment on the mounting brackets to aid in detector installation.

Chief Engineer -- E. O. Nyborg
Senior Engineer -- L. G. Smith
Project Engineer -- G. E. Frehlich

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. A universal detector bracket which fastens to a standard bearing flange providing improved ease of mounting and improved rigidity is under development.
2. The addition of prepunched holes in the detector mounting brackets to aid in detector adjustment is under consideration.

MANUFACTURER'S ADDITIONAL COMMENTS

1. A mechanical and electrical modification to the slow speed shaft detectors to reduce environmental effects is being evaluated.

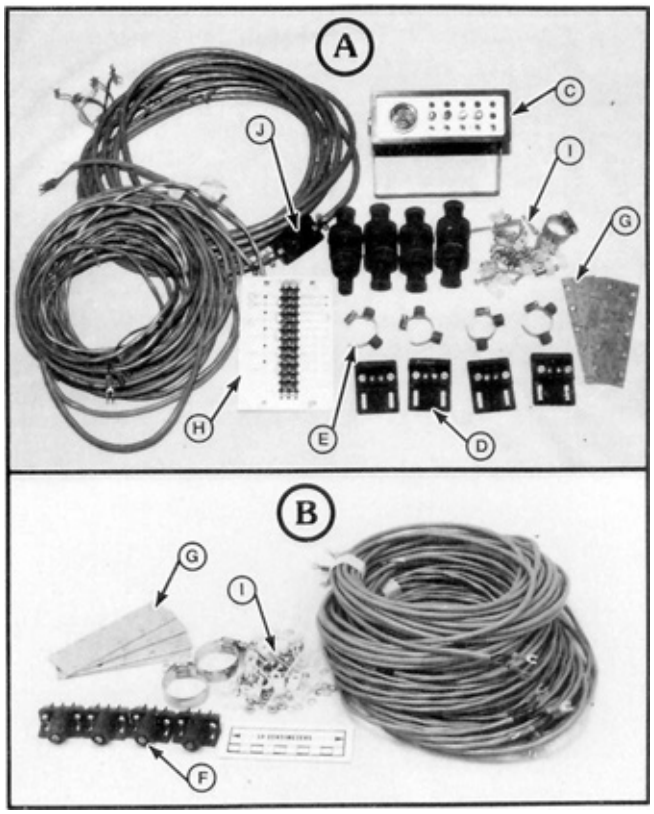


FIGURE 1. BEE Shaft Speed Monitor: (A) drill detector package, (B) combine detector package, (C) control box, (D) slow speed detectors, (E) magnets, (F) high speed detectors, (G) detector mounting brackets, (H) terminal plate, (I) mounting hardware, (J) pull-apart connectors.

GENERAL DESCRIPTION

The BEE model 7614 shaft speed monitor is designed to monitor the rotation of either slow speed shafts, such as grain drill seed metering shafts, or high speed shafts, such as on combine straw choppers. It can be set to warn an operator that shafts have stopped or are turning slower than desired. It is powered by the tractor or combine electrical system and will operate on either positive or negative ground circuits. The standard control box will monitor up to four shafts while optional channel expanders are available for continuous monitoring of up to 12 shafts.

The BEE 7614 consists of a control box which mounts at the operator's station and either a model 7614D slow speed detector package for grain drills or a model 7614C high speed detector package for combines. The slow speed detectors are small magnetic switches that are activated by magnets placed on a rotating shaft. The high speed electromagnetic detectors have no mechanical parts and produce a pulse whenever a moving iron pickup disturbs their magnetic field. Detector packages include the wiring harness, hardware and mounting instructions.

Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The BEE model 7614 was used for 45 hours on a grain drill and for 120 hours on a self-propelled combine. It was evaluated for ease of installation, ease of operation and adjustment, quality of work and suitability of the operator's manual.

RESULTS AND DISCUSSION

EASE OF INSTALLATION

Installation Time: Installation of the BEE 7614 on either a grain drill or a combine was easy but fairly lengthy. It took about five hours to install the system on a grain drill and four hours to install it on a self-propelled combine. Installation instructions were clear and adequate.

Control Box: The control box (FIGURE 2) is mounted at a suitable location in the tractor or combine cab. The control box face should not be positioned in direct sunlight, to provide clear viewing of the channel lights. The control box attaches with two bolts and is wired directly into the vehicle electrical system. When equipped with a pull-apart connector for the detector leads, the same tractor mounted control box may be used for monitoring either drills or a pull-type combine.

Installation on Grain Drills: Installing the slow speed detector system on a grain drill is fairly simple. The magnets (FIGURE 3) which are attached in pairs to standard gear-type hose clamps, are mounted on the seed metering shaft. One magnet pair is needed for each seed shaft. A detector has to be installed adjacent to each magnet pair and is attached to the seed box or drill frame with a mounting bracket. The detector face has to be within 10 mm (0.4 in) of the magnets, with the notch in each magnet at 90° to the face surface.

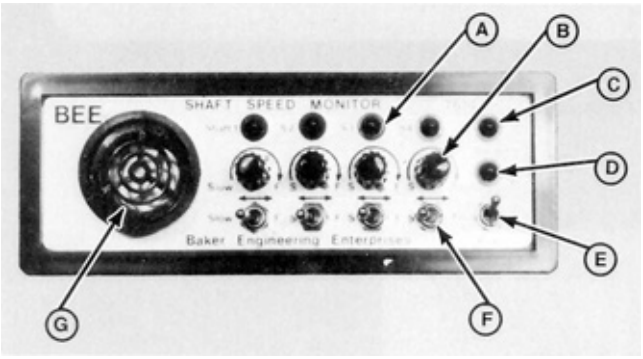


FIGURE 2. Control Box: (A) channel warning lights, (B) speed adjustment dials, (C) switch indicator, (D) 'on' indicator, (E) power switch, (F) speed range switches, (G) buzzer.

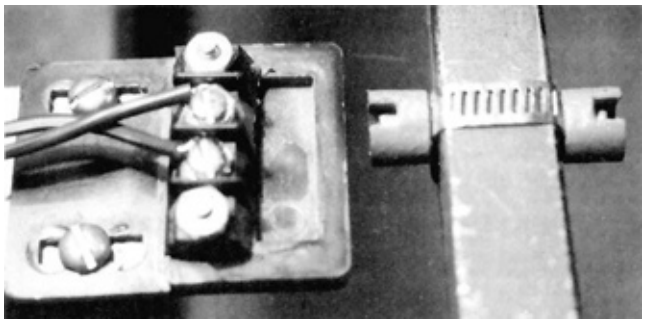


FIGURE 3. Slow Speed Detector, With Magnets Attached to a Drill Seed Shaft.

Installation on Combines: The high speed combine monitoring system did not require the installation of permanent magnets to a rotating shaft. Pulley spokes, bearing set-screws, shaft keys, gear teeth, chain links or other rotating steel projections could be used as a pickup. Hose clamps with iron pickups (FIGURE 5) were also used on shafts having no suitable steel projections. Detectors are attached to the combine body with the mounting brackets and have to be positioned within 4 mm (0.15 in) of the rotating pickup face. Several of the detectors were mounted using modified or fabricated brackets.

Wiring Harness: The wiring harness included plastic hold-down clips and ties for securing cables away from pinch points and moving components. A sufficient number of screws and clips were provided but there was a shortage of cable ties. Connections at the detectors and the meter box contained screw terminals. Cables could be attached either by looping the wires or inserting the crimp-on connectors.

The wiring harness for the grain drill detector package used a common ground for the detectors and an intermediate terminal strip. Pull-apart connectors at the tractor and between individual drills were included to permit unhitching.

The wiring harness for the combine detector package did not use a common ground or an intermediate terminal strip. Detectors were routed directly to the meter box. Pull-apart connectors at the tractor were available as an option for pull-type combines.

EASE OF OPERATION AND ADJUSTMENT

Only occasional adjustments were required for either the combine or the grain drill monitor once the detectors had been properly installed. Occasional checks were needed to ensure that cables were properly attached and clear of moving parts.

Each channel could be switched to either a low or high speed operating range. The low speed range was used with the drill detectors while the high speed range was used with the combine detectors. Each channel was also equipped with a dial for setting the desired alarm speed. This set the shaft speed at which a flashing channel light and buzzer would be activated to signal the operator. Channel lights were quite visible as long as the control box face was not in direct sunlight. The warning buzzer was clearly audible above tractor or combine noise.

Adjustment of the pickup-to-detector clearance was critical, especially for the high speed detectors. The slotted holes in the detectors permitted adjustment in only one direction, usually necessitating bending or twisting of the mounting bracket to obtain final adjustment. It was important not to overtighten the detector mounting bolts as overtightening could crack the detectors.

The detector mounting brackets supplied with the BEE shaft speed monitor were fabricated from light gauge steel. When attached in certain machine locations, detectors vibrated excessively, leading to erratic performance or interference between the detectors and pickups. It is recommended that stiffer mounting brackets be supplied to eliminate this problem.

QUALITY OF WORK

Operating Range: Slow speed detectors were capable of monitoring shaft speeds from 1 to 25 rpm, with the control box on the low speed setting, and with two magnets used on the shaft clamps. Slower shaft speeds could be monitored by attaching more magnets to each shaft clamp. At the high speed control box setting, slow speed detectors could be used for monitoring shaft

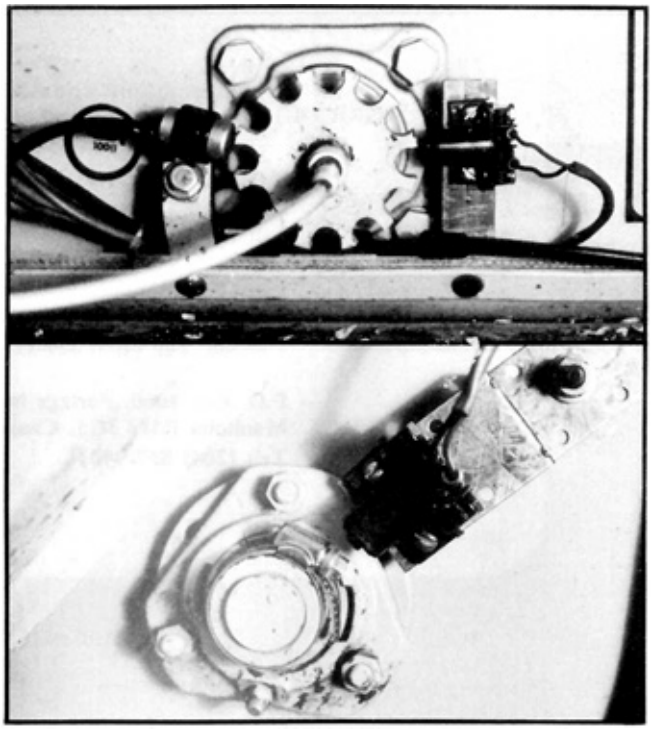


FIGURE 4. High Speed Detectors Installed on a Combine: Top -- Gear Teeth Used as a Pickup, Bottom -- Hose Clamp with Iron Stud Used as a Pickup.

speeds from about 65 to 2300 rpm, when used with dual magnet shaft clamps. High speed detectors are, however more suitable for these speed ranges since they do not incorporate mechanical switches.

High speed detectors were capable of monitoring shaft speeds from about 125 to 3600 rpm with the control box on the high speed setting and with single pickups. The speed range could be lowered by using more than one pickup to obtain more than one pulse per revolution. High speed detectors were not suitable for use on the low speed control box setting.

Signal Strength: Steel objects passing near the face of the high speed detectors disturb the magnetic field at the detector, producing an electrical pulse. The pulse strength increases with shaft speed, with decreased distance between the detector and pickup and with increased pickup size and surface area. The hose clamp pickup supplied with the BEE sometimes did not produce sufficient signal strength. (FIGURE 5) shows a modified hose clamp pickup fabricated by riveting two steel studs to a regular hose clamp. This modification may be used to increase signal strength. The use of more than one stud may also be used to bring a slowly turning shaft within the operating range of the high speed detectors.

FIGURE 5. Modifications to Hose Clamp Pickup to Increase Signal Strength.

Sensitivity: The amount of shaft speed reduction necessary to activate the alarm was adjustable. When using the slow speed detector, with the control box at the low speed setting and with two magnetic pickups on each shaft, the minimum speed reduction required to trigger the alarm varied from 1 to 12% of shaft speed. With the control box at the high speed setting, the minimum shaft speed reduction required to trigger the alarm varied from 1 to 8% of shaft speed.

With the high speed detectors, single pickups and the control box at the high speed setting, the minimum shaft speed reduction required to trigger the alarm varied from 1 to 3% of shaft speed.

For most applications it was suitable to set the sensitivity to cause the alarm to be triggered if the shaft speed reduced by more than 20%. In this way, slipping belts or malfunctioning components could be detected before damage or blockage occurred but minor normal speed variations would not be detected.

Response Time: The time required for the indicator to detect a shaft speed reduction depended upon the shaft speed, the number of pickups used on each shaft and the control box settings. Since the monitor compared the time between consecutive on-off pulses, response time was longer for slowly turning shafts than for high speed shafts. It took about 60 seconds to activate the alarm on very slow shafts while activation was virtually instantaneous on high speed shafts.

Environmental Effects: Detectors were well sealed and were not affected by rain or moisture. Mud accumulation on the slow speed detectors caused a malfunction when seeding one wet field, necessitating detector cleaning. The chaff and dust common to normal combine operation did not hamper detector performance.

OPERATOR'S MANUAL

The operator's manual was very complete, presenting comprehensive installation, operating and adjustment instructions.

POWER REQUIREMENTS

The BEE shaft speed monitor drew a maximum current of 0.15 A and could be attached to a 12 volt electrical system with either a positive or negative ground.

DURABILITY RESULTS

The BEE model 7614 shaft speed monitor was operated in the field for 165 hours. The intent of the test was functional evaluation and an extended durability evaluation was not conducted. No durability problems occurred during functional testing.

APPENDIX I

SPECIFICATIONS

MAKE:	BEE Shaft Speed Monitor
MODEL:	7614
SERIAL NUMBER:	0413
ELECTRICAL POWER REQUIREMENTS:	12V DC
CONTROL BOX:	
-- size	152 x 50 x 117 mm (6 x 2 x 4.6 in)
-- number of channels	4
-- alarm system	buzzer and warning light
-- controls	on-off power switch, shaft speed adjustment dials, speed range switches
CONNECTORS:	screw and crimp-on end connections, pull-apart connectors (standard for model 7614D, optional for model 7614C)
DETECTORS:	
-- type	electromagnetic detectors for high speed operation (model 7614C), magnetic reed switch detectors for slow speed operation (model 7614D)
-- number	4 slow speed detectors (model 7614D) 4 high speed detectors (model 7614C)
OPTIONS:	
-- model 7614C	pull-type combine wiring extension, combine hopper level switch, straw walker plugging switch, slow speed detector package
-- model 7614D	expander to triple the number of shafts monitored for each channel, grain and/or fertilizer hopper level switch, 6.1 m (20 ft) multiwire extension, high speed detector package

APPENDIX II

METRIC UNITS

In keeping with the Canadian metric conversion program, this report has been prepared in SI units. For comparative purposes, the following conversions may be used.

1 metre (m) = 1000 millimetres (mm) = 39.37 inches (in)

ALBERTA FARM MACHINERY RESEARCH CENTRE

3000 College Drive South
Lethbridge, Alberta, Canada T1K 1L6
Telephone: (403) 329-1212
FAX: (403) 329-5562
http://www.agric.gov.ab.ca/navigation/engineering/afmrc/index.html

Prairie Agricultural Machinery Institute
Head Office: P.O. Box 1900, Humboldt, Saskatchewan, Canada S0K 2A0
Telephone: (306) 682-2555

Test Stations:

P.O. Box 1060
Portage la Prairie, Manitoba, Canada R1N 3C5
Telephone: (204) 239-5445
Fax: (204) 239-7124

P.O. Box 1150
Humboldt, Saskatchewan, Canada S0K 2A0
Telephone: (306) 682-5033
Fax: (306) 682-5080